

Water management in Ontario

Ontario
Water Resources
Commission

Great Lakes
Water Quality
Surveys Program

W.Q. LIE -
GREAT LAKES ONTARIO

STANDARDS DEVELOPMENT BRANCH OMOE

36936000010218



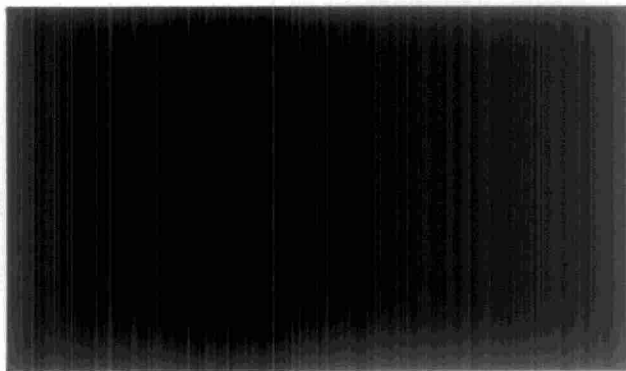
TD
195
.D72
R48
1969
MOE

Copyright Provisions and Restrictions on Copying:

This Ontario Ministry of the Environment work is protected by Crown copyright (unless otherwise indicated), which is held by the Queen's Printer for Ontario. It may be reproduced for non-commercial purposes if credit is given and Crown copyright is acknowledged.

It may not be reproduced, in all or in part, for any commercial purpose except under a licence from the Queen's Printer for Ontario.

For information on reproducing Government of Ontario works, please contact ServiceOntario Publications at copyright@ontario.ca



**TD
195
.D72
R48
1969**

Review of dredging activities in
Ontario waters of the Great
Lakes and their effect on water
quality.

80462

REVIEW OF DREDGING ACTIVITIES
IN ONTARIO WATERS OF
THE GREAT LAKES

and their

EFFECT ON WATER QUALITY

Great Lakes Surveys Program,
Ontario Water Resources Commission,
135 St. Clair Avenue West,
Toronto 195, Ontario.

November, 1969

ACKNOWLEDGEMENT

The co-operation and assistance of the Canadian Department of Public Works in providing the data on dredging activities in Ontario waters of the Great Lakes is gratefully acknowledged.

REVIEW OF DREDGING ACTIVITIES
IN ONTARIO WATERS OF THE GREAT LAKES
AND THEIR EFFECT ON WATER QUALITY

I INTRODUCTION

Dredging encompasses all activities involving the excavation of materials under water. The bulk of dredging carried out on the Great Lakes is associated with the construction or maintenance of marine facilities within harbours or navigation channels. Maintenance dredging is necessitated by the continuing deposition of sediments from streams and the movement of sediments through storm generated currents and littoral drift. In many areas, considerable quantities of sediments originating from industrial and municipal sources are deposited in the vicinity of waste outfalls.

Other dredging activities involve the mining of sand and gravel for commercial use and, to a minor extent, improvements or modification of private shore facilities.

II ADMINISTRATIVE RESPONSIBILITIES

The excavation, transport and deposition of all materials undertaken by man's initiation in Ontario waters of the Great Lakes is primarily controlled by the following government departments and agencies:

Canadian Department of Transport
Ontario Department of Lands and Forests

Ontario Department of Mines
Ontario Water Resources Commission

Safeguards to protect navigation are incorporated in the Navigable Waters Protection Act which is administered by the Canadian Department of Transport. This Act makes it an offence to deposit any material, liable to sink to the bottom, in waters with a depth of less than 120 feet.

The Ontario Department of Lands and Forests, as administrator of Crown Properties, has authority over illegal deposition of dredged material which may cause damage to these properties.

The Ontario Department of Mines regulates the commercial dredging of sand and gravel through the issuance of licences.

The Ontario Water Resources Commission, under its Act, has authority to ensure that no material is deposited in Ontario waters which may be injurious to the quality of these waters.

The Canadian Department of Public Works is also involved with the provisions of the Navigable Waters Protection Act although it does not administer the Act. This federal department serves in a supervisory capacity regarding actual scheduling and conduct of dredging operations related to the maintenance of navigable waters.

III EQUIPMENT

Four basic types of dredges are in common use on the Great Lakes. These are the pipeline and hopper dredges which operate

hydraulically and the clamshell and dipper types which are mechanical.

The most popular dredge used in Canada is the clamshell which requires auxiliary equipment, consisting of scows and tugs, to transport the dredged spoils to the disposal site. Normally, the scows are equipped with discharge doors on the underside which release the load when the vessel is over the disposal site. For disposal on land or in diked areas a clamshell must be provided to unload the scow.

The pipeline dredge equipped with a suction pipe and hydraulic cutter head is commonly used where extensive quantities of sand, silt or clay are to be removed. The dredged spoils are pumped as a slurry through a length of discharge pipe to a diked disposal area.

Dipper and hopper dredges are of more specialized uses and not employed extensively in Canadian dredging operations on the Great Lakes. The hopper dredge, which combines both the digging and disposal operations in one vessel, is however, the type most commonly used by the United States agencies on the Great Lakes.

IV DREDGING PRACTICES

The Ontario Department of Mines has currently outstanding authorizations for the mining of sand and gravel at eight locations on the Great Lakes (see Figures 1 and 2). Two are located near the mouth of the Niagara River, one in Lake Superior and the remainder in Lake Erie. The total quantity of this material removed annually at these locations is estimated at one million cubic yards.

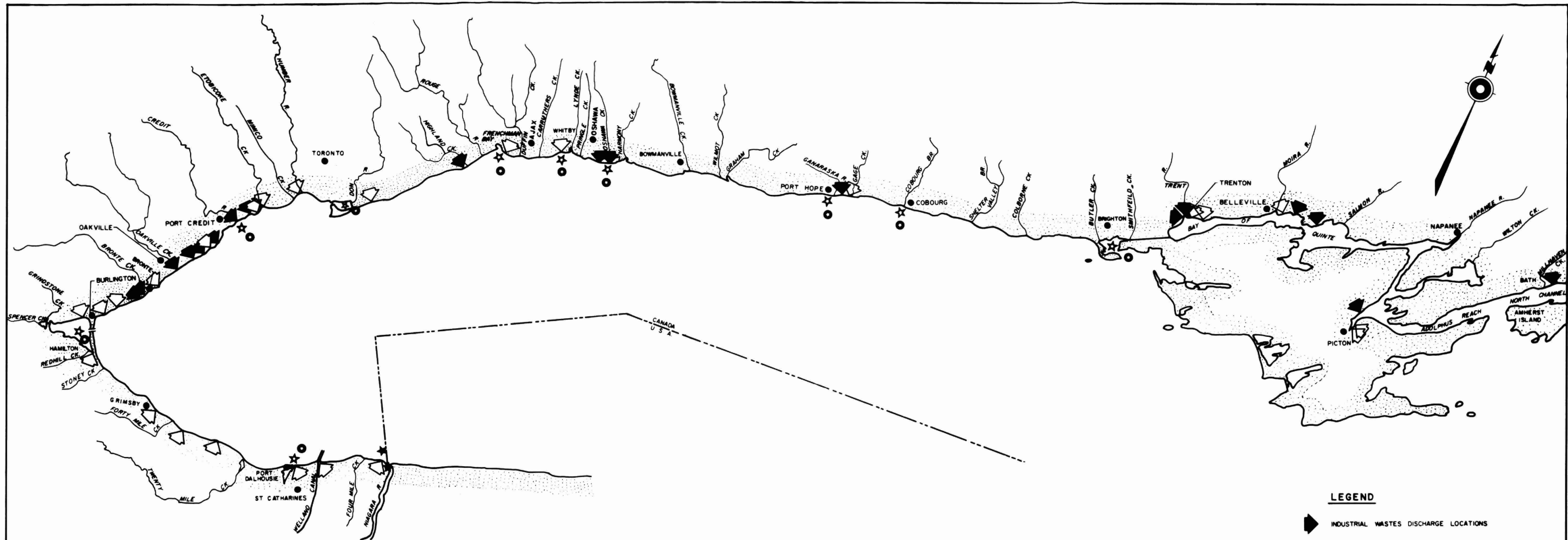


FIGURE N°1 - LAKE ONTARIO

**LOCATION OF COMMERCIAL SAND AND GRAVEL MINING
SITES AND THE CANADIAN DEPARTMENT OF PUBLIC
WORKS DREDGE AND DISPOSAL SITES**

LEGEND

- ▲ INDUSTRIAL WASTES DISCHARGE LOCATIONS
- △ MUNICIPAL DISCHARGE LOCATIONS
- ★ MAINTENANCE AND CAPITAL DREDGE SITES
- DREDGED MATERIAL DISPOSAL SITES
- ★ COMMERCIAL - SAND AND GRAVEL MINING SITES

4 3 2 1 0 4 8 12 16 20 24 MILES

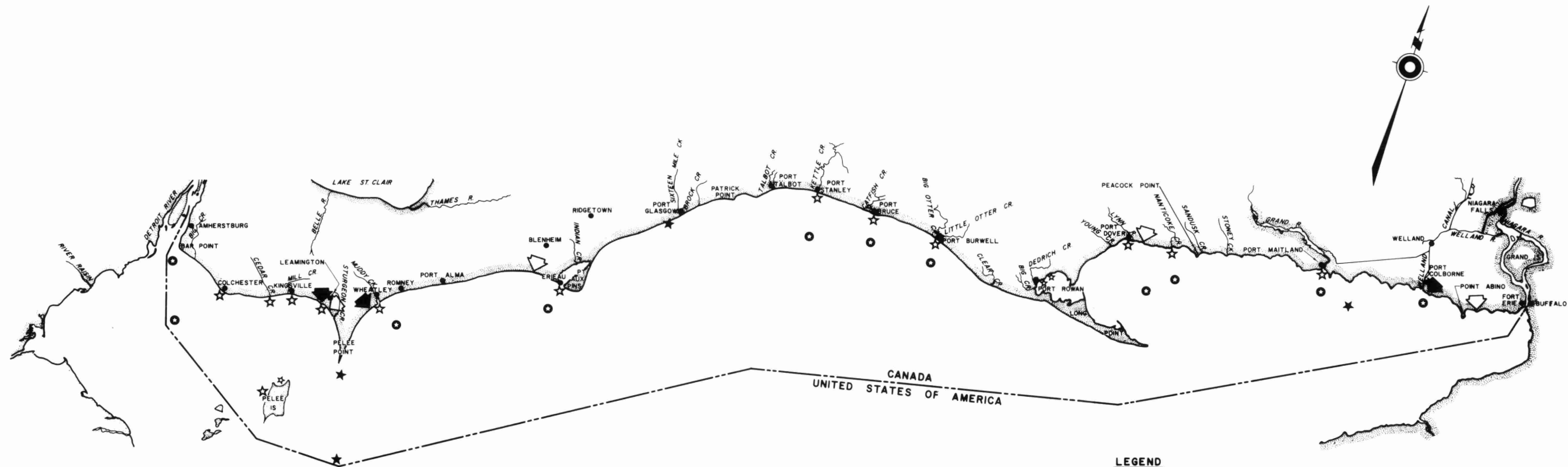


FIGURE No. 2 - LAKE ERIE

LOCATION OF COMMERCIAL SAND AND GRAVEL MINING
SITES AND THE CANADIAN DEPARTMENT OF PUBLIC
WORKS DREDGE AND DISPOSAL SITES

LEGEND

- INDUSTRIAL WASTES DISCHARGE LOCATIONS
- MUNICIPAL DISCHARGE LOCATIONS
- ★ - MAINTENANCE AND CAPITAL DREDGE SITES
- - DREDGED MATERIAL DISPOSAL SITES
- ★ - COMMERCIAL - SAND AND GRAVEL MINING SITES

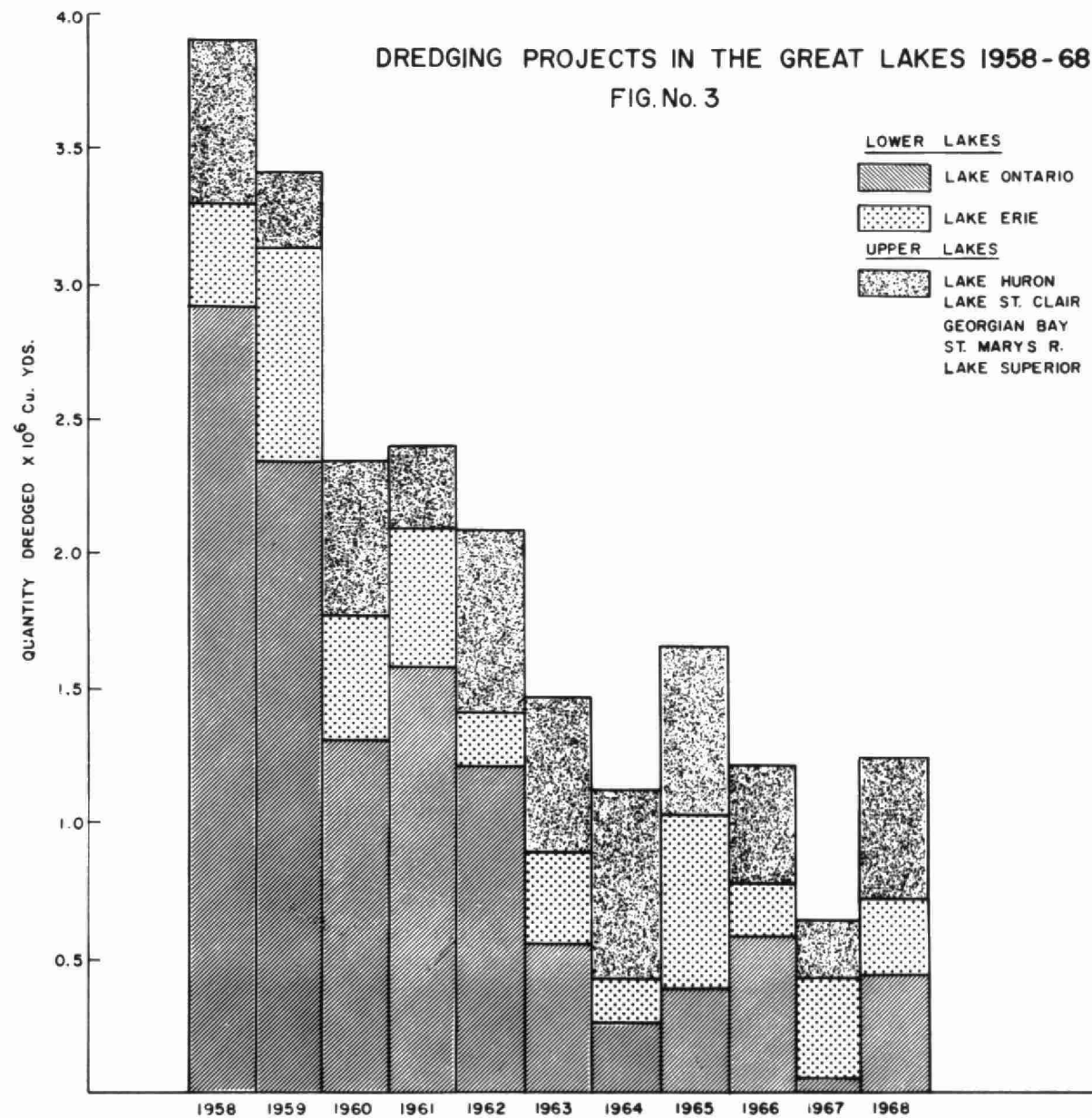
5 4 3 2 1 0 5 10 15 20 25 30 35 40 45 50 55 MILES

The total quantities of material dredged during the ten year period, 1958-68, under the direction of the Canadian Department of Public Works are tabulated in Appendix I. Dredged locations referred to in Appendix I and the adjacent designated disposal areas are noted in Figures 1 and 2. Total quantities of material dredged annually in the Upper Lakes System, Lake Erie and Lake Ontario, during the 1958-68 period are summarized in Figure 3. The quantities dredged annually in the Upper Lakes System and Lake Erie have remained constant within broad limits. The data for Lake Ontario, however, indicates a definite downward trend in the amount of material dredged.

The dredged quantities referred to include both capital and maintenance dredging performed in navigable channels, public harbours, and also cost sharing arrangements in connection with private docking facilities or breakwater construction.

Some of the immediate effects of pick-up and deposition of polluted dredged material are the release of oxygen-demanding materials and nutrients as well as the creation of unsightly conditions produced by high turbidities, floating solids, oil patches, etc.

Disposal of sewage and industrial waste contaminated solids in open lake areas has the effect of transmitting and distributing polluted material from shore areas to clean zones of the lake. One has only to consider the effects of sediments with a high oxygen demand, as encountered in Western Lake Erie, to appreciate that the



characteristics of the lake waters are to a great extent determined by the nature of the sediments. The practice of open water disposal of polluted dredged material is, therefore, of major long term concern.

The decomposition of polluted sediments with the accompanying release of nutrients to the water is a gradual but continuous process. The length of time required for complete degradation of this material is largely dependent on the thickness of the sediment layer, the availability of dissolved oxygen in the bottom waters and the presence and extent of the organisms necessary to the process. Short term studies of dredge disposal sites therefore, do not readily reveal the potential dangers resulting from an accumulation of polluted sediments.

V CONTROL MEASURES AND THEIR IMPLICATIONS

It is apparent that every effort should be made to prevent the deposition of highly polluted material in the Great Lakes System. Furthermore, since this material originates from municipal, industrial and agricultural sources, the ultimate approach to this problem is the provision of adequate pollution control measures at the individual sources.

Although this is the goal which must be pursued, it must also be recognized that we may very well require one or more decades to achieve such objectives as separation of combined sewer systems and

provision of a sufficiently high degree of waste treatment at the major industries. Moreover, existing deposits associated with industrial centres and commercial shipping will retain phenolic and other persistent compounds for prolonged periods. In view of this, disposal methods which will remove dredged material from the Great Lakes System should be employed. Generally, the most economical method of achieving this in harbour areas is disposal of dredged spoils into a diked area via direct pipeline. Transfer to and subsequent disposal into a diked area can also be used. This latter technique has been employed on Grassy Island in the Detroit River since 1960 for disposal of spoils taken from the Rouge River. Disposal in diked areas, compared to deep lake disposal, which does not remove the polluted material from the system, is about three to six times more expensive.

On-land disposal was considered in two instances during the past year. Discussions were held with a view to discontinuing open lake disposal of dredged material from the Kam River and other areas in the vicinity of Thunder Bay, a practice started in 1900. The review was prompted by pollution complaints from local fishermen and other citizens. At that time, it was decided not to proceed with an alternate method of disposal because of cost considerations and difficulty of relating the additional cost to definite benefits.

Based on the quality of sediments in Kingston Harbour, the OWRC recommended that the dredged material be disposed on land. High construction costs of a ponded area have resulted in a delay in the proposed dredging project.

In most cases, the liability for the additional cost of dredging resulting from pollution becomes a matter for debate. In one instance in 1968, the financial liability was partially settled. The Department of Public Works reached an agreement with the Great Lakes Paper Company at the Lakehead, whereby the company would pay the dredging costs attributable to the suspended fibres discharged by the company. No arrangements have, however, been made for the disposal of these waste products on land.

In view of the information at hand, it appears warranted and immediately desirable to discontinue the disposal of polluted sediments in open waters. The recommendation is put forth that the Canadian Department of Public Works or any other party undertaking dredging operations should assume the responsibility to dispose of dredged material in such a manner as not to create further problems of water quality deterioration. The additional cost of disposal in diked areas would consequently have to be borne by such party unless it can be recovered, through negotiations or legal action, from the parties responsible for the pollutants in the sediments.

Based on preliminary data, it is estimated that 100,000 cu. yds. to 300,000 cu. yds., or about 10 per cent of the total quantity dredged annually in the Lake Ontario waters of the Great Lakes could be classified as containing significant amounts of industrial or municipal waste substances unacceptable for disposal in open waters.

The OWRC should, in co-operation with the Canadian Department of Public Works, undertake a systematic sediment classification for dredge areas to assist in the planning and costing of dredge projects. The Commission should furthermore provide the necessary technical assistance for the recovery of dredging costs resulting from the introduction of raw or inadequately treated wastes to the sediments.

APPENDIX I

SUMMARY OF QUANTITIES DREDGED UNDER DIRECTION OF CANADIAN DEPARTMENT OF PUBLIC WORKS - CUBIC YARDS

| <u>LAKE ONTARIO</u> | <u>1958</u> | <u>1959</u> | <u>1960</u> | <u>1961</u> | <u>1962</u> | <u>1963</u> | <u>1964</u> | <u>1965</u> | <u>1966</u> | <u>1967</u> | <u>1968</u> |
|---------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| COSBOURGH | 43,675 | 33,872 | 16,382 | 21,125 | 20,176 | 8,277 | 86,404 | - | 45,853 | 10,978 | - |
| FRENCHMAN'S BAY | 7,275 | - | - | - | - | - | - | - | - | - | - |
| HAMILTON | 1,788,066 | 972,908 | 687,116 | 277,385 | 23,082 | 257,388 | - | 123,000 | 200,000 | 24,600 | 562,922 |
| INDIAN POINT | - | - | - | - | - | - | 1,431 | - | - | - | - |
| KINGSTON | - | - | 19,000 | 43,678 | 2,063 | 126,324 | - | - | 1,374 | - | - |
| OSHAWA | 128,870 | 41,623 | 23,400 | 19,300 | 42,425 | 121,834 | 13,751 | 40,010 | 49,947 | - | - |
| PORT CREDIT | 40,000 | - | 20,000 | 147,795 | - | - | - | - | - | - | - |
| PORT HOPE | 43,300 | 22,064 | 28,428 | 37,168 | 26,330 | 19,082 | 17,355 | 27,145 | 14,058 | 19,846 | - |
| S'MCOE ISLAND | - | - | - | - | - | - | - | - | - | 2,292 | - |
| ST. CATHARINES | - | - | - | - | - | - | - | - | - | - | - |
| TORONTO | 748,000 | 1,248,313 | 334,503 | 965,000 | 758,530 | 15,230 | 120,110 | 197,252 | 277,133 | - | - |
| WHITBY | 141,841 | 30,000 | 170,565 | 79,260 | - | - | 16,724 | - | - | - | - |
| WOLFE ISLAND | - | - | - | - | 330,200 | - | - | - | - | - | - |
| TOTAL CUBIC YARDS | 2,942,427 | 2,348,780 | 1,308,874 | 1,521,731 | 1,209,806 | 548,135 | 255,775 | 397,007 | 528,425 | 57,716 | 563,922 |

APPENDIX I (CONT'D)

SUMMARY OF QUANTITIES DREDGED UNDER DIRECTION OF CANADIAN DEPARTMENT OF PUBLIC WORKS - CUBIC YARDS

| <u>LAKE ERIE</u> | <u>1958</u> | <u>1959</u> | <u>1960</u> | <u>1961</u> | <u>1962</u> | <u>1963</u> | <u>1964</u> | <u>1965</u> | <u>1966</u> | <u>1967</u> | <u>1968</u> |
|-------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| CEDAR BEACH | 3,25 | 3,538 | - | - | - | - | - | 6,538 | - | 6,482 | - |
| COLCHESTER | 10,314 | 600 | - | - | - | - | 11,974 | - | - | - | - |
| KINGSVILLE | 98,494 | - | 15,420 | 98,382 | - | 62,815 | - | 61,217 | - | - | - |
| LEAMINGTON | - | 113,651 | - | 8,943 | 26,174 | 5,852 | 71,141 | - | - | - | 15,699 |
| NANTICOKE | - | 7,421 | - | - | - | - | - | 12,442 | - | - | - |
| PELEE ISLAND | - | - | - | 5,685 | - | - | 9,407 | - | - | - | - |
| FORT BRUCE | 4,590 | 175,084 | - | - | - | - | - | - | - | - | - |
| FORT BURWELL | 152,001 | 232,128 | 239,364 | 224,477 | 66,309 | 186,502 | 42,214 | 345,670 | 142,828 | 242,026 | 211,109 |
| FORT DOVER | - | - | - | 23,410 | - | - | - | - | - | - | 43,745 |
| FORT ELGIN | - | 1,375 | - | - | - | - | 15,793 | - | - | - | - |
| FORT MAITLAND | - | 50,652 | 22,475 | 28,200 | - | - | - | - | - | - | - |
| FORT ROWAN | 16,456 | 17,790 | - | - | - | - | - | - | - | 15,246 | - |
| FORT STANLEY | 82,399 | 101,428 | 84,457 | 109,583 | 72,162 | 82,672 | 13,030 | 111,206 | 20,985 | 91,894 | 113,430 |
| RONDEAU (ERIEAU) | 60,000 | - | 32,620 | - | 9,200 | - | 3,264 | 11,664 | 17,685 | 20,432 | 22,406 |
| ST. WILLIAMS | - | - | - | 3,867 | - | - | - | - | - | - | - |
| WHEATLEY | 12,710 | 10,602 | - | 16,071 | - | - | - | 13,039 | - | - | - |
| TOTAL CUBIC YARDS | 440,594 | 773,024 | 460,786 | 518,124 | 196,847 | 337,841 | 171,823 | 646,540 | 181,508 | 376,250 | 406,469 |

APPENDIX I (CONT'D)

SUMMARY OF QUANTITIES DREDGED UNDER DIRECTION OF CANADIAN DEPARTMENT OF PUBLIC WORKS - CUBIC YARDS

| <u>UPPER LAKES SYSTEM</u> | <u>1958</u> | <u>1959</u> | <u>1960</u> | <u>1961</u> | <u>1962</u> | <u>1963</u> | <u>1964</u> | <u>1965</u> | <u>1966</u> | <u>1967</u> | <u>1968</u> |
|---------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| BAYFIELD | - | - | 22,597 | - | - | - | 21,231 | - | - | - | - |
| GODERICH | 52,262 | 68,956 | - | - | 110,040 | 139,806 | 109,445 | - | - | - | 350 |
| GRAND BEND | - | 17,000 | - | - | - | 3,739 | 17,144 | - | - | - | - |
| HOWDENVALE | - | - | - | - | - | - | 7,422 | - | - | - | - |
| KINCARDINE | - | 9,687 | - | - | - | - | 14,130 | - | - | - | - |
| GLIPHANT | - | 618 | - | - | - | 9,895 | 2,086 | - | - | - | - |
| PERCH CREEK | - | 5,500 | - | - | - | - | - | 2,361 | - | - | - |
| SARNIA | - | - | 7,920 | - | 23,666 | - | 19,213 | - | 142,625 | - | - |
| SOUTH BAYMOUTH | - | - | - | - | - | - | 5,051 | - | - | - | - |
| STOKES BAY | - | - | - | - | - | - | 11,270 | - | - | - | - |
| BLIND RIVER | - | - | - | - | - | - | - | 37,250 | - | - | - |
| LITTLE CURRENT | - | - | - | - | - | - | - | - | - | - | - |
| SHEGUINDAH | 2,710 | - | - | - | - | - | - | - | - | - | - |
| SPANISH RIVER | - | - | - | - | - | - | 20,351 | - | - | - | - |
| HONEY HARBOUR | 10,611 | - | - | - | - | - | 1,300 | - | - | - | - |
| INSIDE STEAMER CHANNEL | - | - | - | - | - | 4,370 | 11,046 | 12,637 | - | - | - |
| MIDLAND | - | - | - | - | - | 72 | 81,166 | - | - | - | - |
| HARRY SOUND | - | - | - | - | - | - | - | - | 39,327 | - | - |
| PENETANGUISHENE | - | - | - | - | - | - | - | - | 3,107 | - | - |

UPPER LAKES SYSTEM CONTINUED . . .

(OVER)

APPENDIX I (CONT'D)

SUMMARY OF QUANTITIES DREDGED UNDER DIRECTION OF CANADIAN DEPARTMENT OF PUBLIC WORKS - CUBIC YARDS

| <u>UPPER LAKES SYSTEM (CONTD.)</u> | <u>1958</u> | <u>1959</u> | <u>1960</u> | <u>1961</u> | <u>1962</u> | <u>1963</u> | <u>1964</u> | <u>1965</u> | <u>1966</u> | <u>1967</u> | <u>1968</u> |
|------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| PORT McNICOLL | - | - | - | 5,318 | - | - | - | - | - | - | - |
| WAUBAUSHENE | - | - | 17,107 | 2,024 | 1,334 | - | - | - | - | - | - |
| WILKINSON | - | - | - | - | - | - | 13,887 | - | - | - | - |
| SAULT STE. MARIE | - | - | - | 2,698 | 46,569 | 19,430 | 18,500 | 4,400 | - | - | - |
| GRCS CAP | - | - | - | - | - | - | - | 4,536 | - | - | - |
| LAKEHEAD | 423,338 | 167,677 | 527,104 | 279,675 | 487,871 | 317,404 | 375,038 | 448,556 | 238,285 | 181,586 | 278,108 |
| TOTAL CUBIC YARDS | 525,321 | 270,738 | 575,528 | 289,715 | 677,402 | 516,777 | 659,250 | 509,740 | 420,217 | 181,586 | 278,956 |

Date Due

| | | | |
|--|--|--|--|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

W.Q. LIB

PRINTED IN CANADA